Command and Control in Peace Support Operations
Model PAX - Approaching new Challenges in the Modeling of C2

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
SEP 2004		**00-00-2004 to 00-00-2004**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Command and Control in Peace Support Operations Model PAX - Approaching new Challenges in the Modeling of C2	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **EADS Dornier GmbH, SDOR,88039 Friedrichshafen, Germany, ,**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
9th International Command and Control Research and Technology Symposium

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**5**	

Abstract

The issue of Command and Control (C2) is not only of importance if talking about purely military processes and structures. The agent-based model PAX addresses basic concepts for dealing with C2 phenomena on the intra-civilian side and the interaction between the military and the nonmilitary side. PAX focuses on the evolvement of aggressiveness and possibilities for de-escalation in Peace Support Operations.

Introduction

As summarized by the NATO Code of Best Practice for C2 Assessment (2002), military research and analysis concentrates predominantly on the physical domain. C2 issues are more than physics dominated problems. They deal with distributed teams of humans and behavioral and cognitive aspects of human entities.

Examining Peace Support Operations (PSO), we especially notice that the issue of Command and Control (C2) is not restricted to the military side only. The interaction of the military with the non-military side – at least in certain cases – may also be seen as a complex C2 process including several aspects of human behavior. Also if looking exclusively on the civilian side, we may describe the interactions between civilian leaders (any people of influence like politicians, religious leaders) and regular people in terms of C2 processes that play together with psychological processes.

This paper introduces the idea that the issue of Command and Control (C2) is not only of importance if talking about purely military processes and structures. Basic concepts for dealing with C2 phenomena on the intra-civilian side and the interaction between the military and the nonmilitary side are demonstrated in the agent-based PSO model PAX. PAX – a prototypical simulation model developed by EADS Dornier for the German Bundeswehr in the international context of the USMC based Project Albert – focuses on the modeling of military operations where the behavior of nonmilitary entities plays an important role. The behavior of the nonmilitary side is modeled based on empirical knowledge about the evolvement of aggressiveness.

Model PAX – Agent Based Modeling of Peace Support Operations

Since the focus is on providing help and de-escalating problematic situations, Peace Support Operations, e.g. Humanitarian Assistance Operations, can not be modeled with existing combat models in an adequate way.

The *agent based* approach is appropriate, because it is better possible to represent the actual situations close to reality: An important essence of the term "agent based" in the context of modeling is that real entities are correspondingly modeled as entities in the simulation model as well.[1] Agent based models are able to model the non-linear effects caused by the behaviour of individuals and their influence on the emerging behaviour of groups. Therefore, we are able to trace, understand and assess what is happening in the model and compare those results with a comparable real situation.

PAX is a prototypical agent based model with the focus on peace support operations, developed by EADS Dornier, initiated and funded by the Bundeswehr TRADOC and assisted by the Operations Research Division of the Bundeswehr Center for Analyses and Studies.

[1] This – depending on the set of questions – can also be meant in an aggregated sense, e. g. that a group of soldiers is represented by a single "soldier group" agent.

PAX concentrates on the modeling of peace - keeping aspects. So far, the main effort lies on modeling civilians. PAX enables the user to investigate the effects of different actions of the military under certain conditions on the civilian side. PAX is able to show dependencies of the soldiers' behaviour on the escalation / de-escalation of the situation. It is not combat or attrition orientated. Therefore it is more suitable for the analysis of peace support operations like humanitarian assistance operations or operations in the context of nation building processes.

In the application of the model PAX we are not only looking at the results of single runs of the simulation. The results of thousands of simulation runs may be statistically analyzed or e. g. visualized in fitness landscapes that clearly show the success of certain strategies and the effects of abilities in a certain context – represented by certain parameters that cover important aspects of the situation. E. g., it is possible to compare strategies that try to de-escalate the situation without any use of violence with "Zero tolerance" strategies where the soldiers react to the first act of aggression by the civilian side without any "diplomacy".

The success of strategies like that may be measured in completely different *MOEs*[2], e. g. like (i) the overall escalation during the operation (e. g. counted by the acts of aggression performed by the civilian side), (ii) amount of provided help (e. g. number of distributed food packages) or even indicate (iii) possible long term effects (number of very scared civilians, anger on civilian side caused by the operation, ...). The complexity of peace support operations, including certain operations for humanitarian assistance, requires that a whole variety of aspects and possible effects has to be looked at in analysis. There is no clear black and no clear white in the roles of the participants of an operation (the behaviour of the civilians may rapidly change e.g. from neutral or even friendly to the opposite because of "small" events ; on the military side the soldiers have to fulfill completely different roles depending on the situation). This degree of complexity (or the "grey" character) of PSO is especially valid for the results. What are "good" results of an operation? Achieving nearly no escalation by heavy show of force? Providing a maximum of help, even if the chance for getting into dangerous situations rises because of that?

A model like PAX – for sure – is not and will not be able to answer *all* questions like that. But, at least, it is able to indicate possible effects of operations that could happen under certain conditions. E. g. the analysis of a food distribution vignette showed that (i) timing of actions was very important, (ii) tactics where the peace – keepers do not use any violence and do not even threaten the civilians seem always to be the best choice regarding the distribution of food but – most of the time – work really bad regarding escalation, (iii) in some cases those peaceful tactics worked bad only at first sight: after a "hot" phase of escalation the crowd calmed down and the operation ended up successful, (iv) "zero tolerance" tactics most of the time come with little escalation but seem to jeopardize the long term objectives of the peace keeping force and (v) objectives like achieving de-escalation and distributing a high number of food packages are competing and seem to require different strategies, depending on the situation.

The interpretation of the outcomes of the model and by looking at the reasons for those outcomes by looking at the corresponding characteristic simulation runs, military leaders who have to make decisions in comparable operations could take some benefit. This may help in a way that they are better aware of what *could* happen in consequence to their decisions. As in

[2] Measures of Effectiveness

any military operation (and in general in empirical sciences), it is not possible to make a clear prediction what *will* happen with complete confidence. The maximum that can be achieved is to achieve a certain degree of statistical confidence.

C2 Processes in PAX

PAX, so far, concentrates mainly on the modeling of *civilians* in Peace Support Operations. The *military* side is not modeled as "detailed" as the civilians regarding the human side of their behavior. Soldier "agents" are modeled in an aggregated way. They represent small groups of real soldier (infantry) entities that behave "ideally" according to certain rules. There are no psychological aspects represented in the soldier agent's behavior in PAX, so far. This enables the analyst to clearly look at consequences of certain tactics without having to deal with "weaknesses" of the human side of the military protagonists.[3]

So, PAX does not include C2 processes within the military side, so far.[4] We try to deal with new aspects of modeling C2 processes that extend the intra-military context.
In PAX, civilian groups may have ringleaders. Those leaders may have a strong influence on the "normal" group members, including the possibility to pass messages with certain semantics. Soldiers are able to communicate with civilians, especially with the leaders.

The communication between the military with civilians may be looked at as a certain way of giving commands: Soldiers, e. g., may tell civilian leaders to leave a critical area together with their group.
From the modeling perspective, one of the crucial points is, that the reaction of the adressee of a message should not be prepotted. The adressee needs to be free to make any decision if and how to react to the contents of a message.
This decision process may be influenced by the (interpreted) contents of the message and the state of the agent including the perceived circumstances and expected consequences. In the modeling context, the state of an agent consists of the the motivational state, the emotional state, the physical state, the equipment and the social status of the agent. The perceived circumstances may also be seen as the knowledge of the agent about the overall situation and therefore may also be seen as part of the "state" of an agent.
This process of giving commands and controlling the consequences (the reaction of the civilians) may be complex.
In PAX, there are several aspects that include the human side of this process: If a soldier agent tells a civilian leader to leave the area, the civilian leader checks – technically spoken – his emotional state. If his emotional level (e. g. anger) is below a certain threshold (which depends on the personality and the "sidedness" of the leader", the leader makes a cognitive decision to cooperate with the military side and tells his group to leave the area. If the emotions are too high, the leader does not cooperate and, e. g. simply ignores the message.

This leads to the second main aspect of modeling C2 in the PAX model: The intra-civilian C2 processes.
The phrase "leadership" straightly leads to thoughts about Command and Control. So, if we talk about civilian leadership and civilian leaders, we also may think of command and control processes if we deal with the interaction of civilian leaders with other civilians.

[3] But human aspects of the military could be included, if necessary (depending on the question sets).
[4] This could be included, for sure. But, so far, our intention was to show that there are other aspects of C2 and to prove that those aspects could be modeled.

In PAX, civilian leaders may not only influence other civilians implicitly by their mere presence. They also may pass messages to their group members (or other civilians). This process is similar to the communication process between soldier agents and civilian agents: Recipients of a message evaluate the contents and make – depending on their state – a decision if and how to react to the contents of the message. In this simple example, after receiving the message to follow the leader and leave the area, a civilian may react in the proposed way, ignore the message (or simply do the opposite…).

Future Work

Besides an usage in a sense of analysis, a further developed version of PAX in future could provide help in assisting the preparation of operations: The operations could be analyzed in respect to many different possible conditions before a decision is made how to go in the operation.

There are plans to use PAX in the context of training and exercise. This will be done in combination with an interactive 3D virtual environment. One of the goals is to be able to assist the evaluation of decisions of the trained commanders by providing results of the simulation tool and demonstrating a variety of possible consequences of the decisions made.

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